

REMARKS

In view of the following remarks, reconsideration of the rejections and further examination are requested. Claims 20, 21, 24-27 and 30-34 remain pending with claim 20 being independent. No new matter has been added.

Rejections Under 35 U.S.C. §103(a)

Claims 20, 21, 24-27, 30, 31, 33 and 34 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over McReynolds (U.S. 6,191,043) in view of Collins et al. (EP 0472941 A2) and Nagata et al. (Japanese Journal of Applied Physics, Vol. 28, No. 11, November 1989, pp. 2368-2371) as evidenced by Tzeng et al. (J. Electrochem. Soc. Vol. 134, No. 9, September 1987, pp. 2304-2309).

Applicants respectfully traverse this rejection and submit that the claims as currently pending are allowable over the cited prior art. In particular, claim 20 requires a plasma etching method in which an etching gas containing a fluorine compound gas (SF₆ gas or NF₃ gas) and He gas, but does not contain O₂ gas, is supplied with electricity having a frequency of 27 MHz or more to energize the etching gas into a plasma state, and in which a volumetric flow rate of the He gas is equal to or more than 80% of a total flow rate of the etching gas.

The method recited in claim 20 enables only one process of the etching to form a trench having a high aspect ratio, preventing side etching from occurring in the trench.

The cited prior art fails to disclose or render obvious such a method. In particular, McReynolds discloses, in Column 1, lines 28-35, etching gas which contains SF₆ gas as fluorine compound gas and He gas as rare gas. McReynolds also discloses, in Table 2, that a volumetric flow rate of the He gas is equal to or more than 80%.

Collins discloses, in the Abstract, that plasma is generated by applying electricity having a frequency within a range from 50 MHz to 800 MHz.

Furthermore, Nagata discloses, in FIG. 5, that when etching gas which contains NF₃ gas and O₂ gas is used in etching, the etching rate is monotonically increased as concentration of the O₂ gas is decreased. Moreover, Nagata discloses, in FIG. 4, that when etching gas which contains NF₃ gas and O₂ gas is used in etching, an etching selection ratio (selectivity) of Si to SiO₂ is increased as concentration of the O₂ gas is decreased.

However, none of the cited references discloses that an etching gas that contains fluorine

compound gas and He gas, but does not contain O₂ gas, is applied with power having a frequency of 27 MHz or more to energize the etching gas into a plasma state.

The Examiner has stated that it would have been obvious to one of ordinary skill in the art to modify McReynolds by removing oxygen, based on the disclosure of Nagata, to render this element of claim 20 obvious.

However, Nagata discloses, in FIG. 5 (*see* the black and white dots), merely that an etching rate is monotonically increased as concentration of O₂ gas is decreased in etching with an etching temperature of 400°C. Thus, McReynolds teaches away from Nagata, since in Table 1, McReynolds discloses that etching is performed at an etching temperature ranging from 20°C to 70°C. Therefore, the etching temperature in McReynolds is significantly different from that of Nagata. As a result, it would have been impossible for one of ordinary skill in the art to modify McReynolds with the teachings of FIG. 5 of Nagata. That is, since Nagata discloses an etching temperature of 400°C, one of ordinary skill in the art would not have modified McReynolds with the Nagata etching, since McReynolds etching is performed between 20°C and 70°C.

Moreover, Applicants submit that McReynolds does not disclose the selective etching of Si or SiO₂. Therefore, one of ordinary skill in the art would not have modified McReynolds with the disclosure of FIG. 4 of Nagata to improve the etching selection ratio (selectivity) of Si to SiO₂.

Therefore, Applicants submit that independent claim 20 and its dependent claims are allowable over the cited prior art.

Claim 32 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over McReynolds in view of Collins and Nagata as evidenced by Tzeng as applied to claims 20-31 above, and further in view of Okumura (U.S. 2003/0034542).

Applicants submit that since claim 32 is dependent from claim 20, and since Okumura fails to overcome the deficiencies of McReynolds, Collins and Nagata, as evidenced by Tzeng, claim 32 is allowable for the reasons set forth above.

Conclusion

In view of the foregoing amendments and remarks, all of the claims now pending in this application are believed to be in condition for allowance. Reconsideration and favorable action are respectfully solicited.

Should the Examiner believe there are any remaining issues that must be resolved before this application can be allowed, it is respectfully requested that the Examiner contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

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